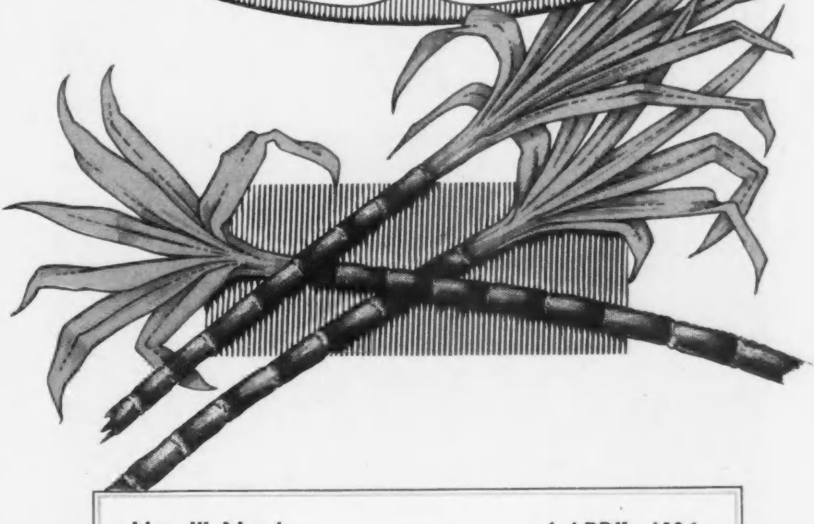
DEPARTMENT OF AGRICULTURE AND STOCK.

The CANE GROWERS' QUARTERLY BULLETIN

ISSUED BY

BUREAU OF SUGAR EXPERIMENT STATIONS

BRISBANE. QUEENSLAND.



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BUREAU OF SUGAR EXPERIMENT STATIONS
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ISSUED BY DIRECTION OF THE
HON. F. W. BULCOCK, MINISTER
FOR AGRICULTURE AND STOCK

1 APRIL, 1936

DAVID WHYTE, GOVERNMENT PRINTER, BRISBANE

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The

The Cane Growers' Quarterly Bulletin

Vol. III | 1 APRIL, 1936 | No. 4

Some Important Factors in Cane Irrigation.

By H. W. Kerr.

IN the October, 1934, number of the Cane Growers' Quarterly Bulletin (page 25) were reported the results of an irrigation trial conducted at the Bundaberg Experiment Station. A small block of P.O.J. 2878 was March-planted and given weekly irrigation treatments until harvested. In order that plant-food deficiencies might be avoided, monthly applications of fertilizer were also made. Under these conditions it was possible to follow the relationship between atmospheric temperature and crop growth. As reported, the plant cane at eighteen months yielded 93·4 tons per acre, with a c.c.s. of 12·1 per cent.; the monthly growth rate was also presented, and the striking differences between these rates for respective months were emphasised.

The block was ratooned and the first ratoon crop harvested in October last, when the cane was twelve months old. This crop gave 72·8 tons of cane per acre, with a c.c.s. of 13·0 per cent.

It is freely admitted that the conditions under which these crops were produced could not be duplicated on a farm scale, and that no grower would in any case find it profitable to produce crops of this magnitude due to the danger of lodging. It is also true, however, that the average return from irrigated cane in Queensland falls far below the values recorded here, even where the water employed in the growth of the crop is comparable in amount. It is therefore proposed to discuss the growth rates recorded from these trials, and see whether it is possible to relate the factors—water used and crop produced—so as to give us a clue to our problem.

Fig. 30 is a graphical representation of the monthly growth rates for the first ratoon crop of the trial. These data were calculated from weekly growth measurements made on a large selection of tagged stalks, and the tonnage of cane produced over a given period was calculated from the elongation recorded during that time in relation to the total length of stalk, which is regarded as proportional to the actual tonnage at harvest time. It is appreciated that allowance should be made for variations in the thickness of stalk; but omission of this consideration will not seriously affect the argument.

Due to the excellent growing conditions which were provided the young ratoons made rapid progress and millable cane was showing early in November. The growth rate slackened towards the end of the month,

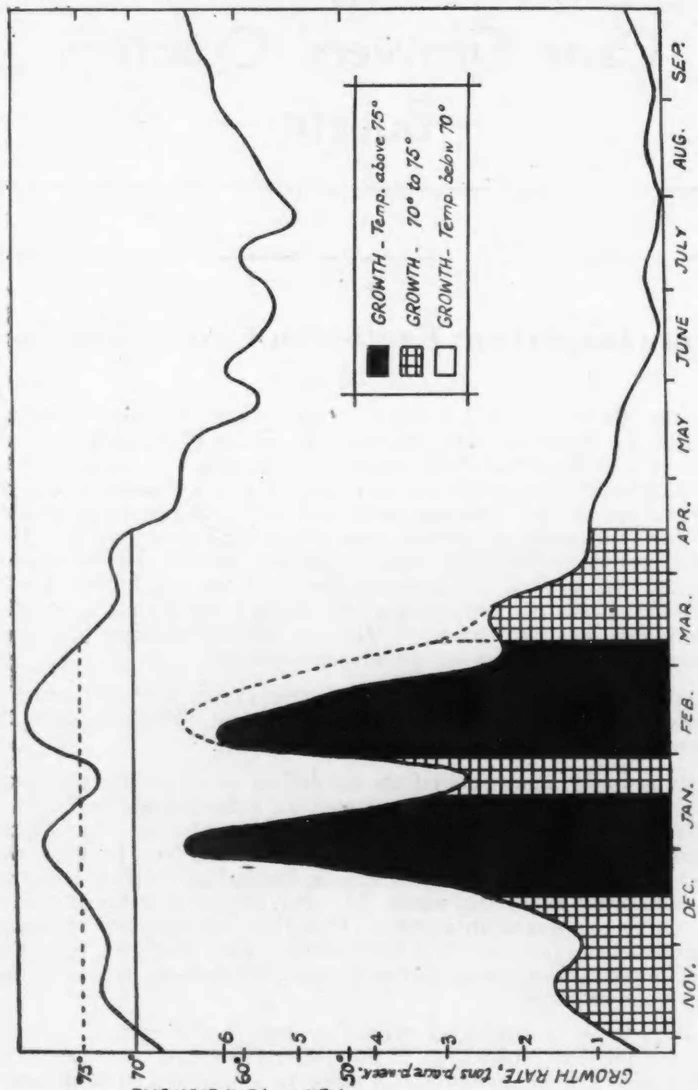

Fig. 30.

Graph illustrating the growth rate of a ratoon crop of P.O.J. 2878 at the Bundaberg Experiment Station, 1934-35 season, together with the mean atmospheric temperature curve for the period.

During February trouble was experienced with the irrigation plant, and the dotted portion of the curve suggests the maximum growth rate obtainable.

but then increased to its maximum for the season during the early days of January, to be followed by a well-defined check rising to a second maximum early in February. Thereafter the growth rate declined steadily until the beginning of June, when growth was virtually suspended throughout the ensuing three months, despite an abundance of available plant food and soil moisture.

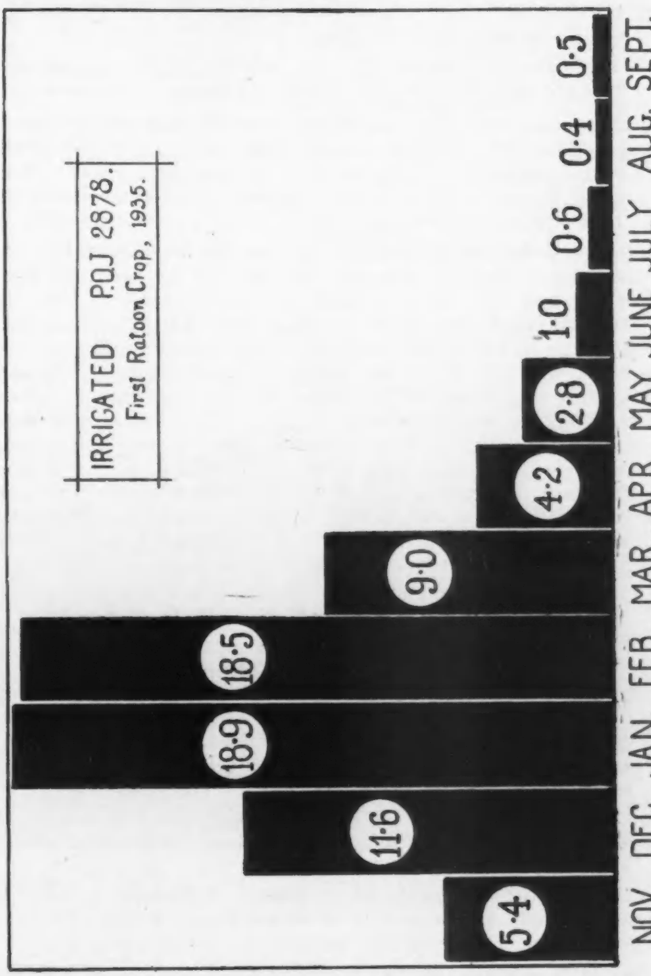

Fig. 31.

The blocks represent, by their height, the average monthly growth rates, while the figures in the circles give the actual cane tonnage produced during the month.

The actual cane production per month (Fig. 31), as calculated from the growth measurement records, was more than 18 tons per acre for both January and February, while for the three summer months—December to February—the total crop growth was 49 tons of cane per acre. As this is in itself an accomplishment of which any cane grower would be proud for a full year's growth, it may be well to investigate the factors involved in this phenomenal performance.

In Fig. 30 is recorded also the mean atmospheric temperature curve. It will be observed that provided soil moisture deficiencies have been eliminated there exists a very close correlation between temperature and growth rate. The following points are clearly demonstrated:—

(1) Vigorous cane growth commences when the mean temperature rises above 70° F., and declines when it falls below this limit.

(2) Between the limits of mean temperature, 70–75° F., the rate of growth increases at a rapid rate.

(3) When the mean temperature exceeds 75° F., the cane growth rate amounts to more than 6 tons of cane per acre *per week.*

An attempt has been made to bring out these facts more clearly by checking and blocking in those areas of the curve representing the above temperature ranges. It is then observed that the growth check recorded during January was due entirely to a "cool change" in the weather at that time.

The obvious deduction is that for best results from irrigation the farmer must work by the thermometer. So long as the mean daily air temperature lies below 70° F. nothing is gained by excessive watering of the crop; when the seasonal values rise above this figure the cane will make good use of all the soil moisture it can acquire; and when the mean temperature exceeds 75° F. the irrigation plant should be operated day and night for maximum results. In a previous paper on irrigation it was stated that in the production of 1 ton of cane the equivalent of 1¼ to 1½ acre-inches of water are absorbed from the soil by the crop and evaporated from the cane leaves. A growth rate of 6 tons of cane per week, therefore, demands from 7 to 9 acre-inches of water per week. In the absence of adequate rainfall the average pumping plant would be fully taxed to supply this quantity of water even when working continuously. Thus, for a grower watering 40 acres of cane, the daily water consumption would be about 40 acre-inches, or 900,000 gallons; this is practically the average output of a 7-inch centrifugal pump operated day and night.

On the evidence presented it is difficult to over-emphasise this point. No quantity of water applied to the particular crop in question after the month of April could possibly induce vigorous cane growth; for the long, warm days were then past and such water as was supplied merely served to maintain the crop in good condition until harvested. The ideal watering system would then be:—

(*a*) Apply sufficient water to the crop during the spring, autumn, and winter months to avoid any check in growth or any distress due to wilting.

(*b*) During the three summer months it is scarcely possible to over-supply the land with moisture under average farming conditions.

Even when beneficial rains fall watering should be resumed almost immediately; for even under the best of conditions the depth of soil drawn on by the crop roots will not hold more than 5 or 6 acre-inches of available moisture—barely a week's supply during the heat of mid-summer.

Such a policy, though doubtless imposing heavy demands on the irrigation plant at this season, would lead in the aggregate to both greater cane tonnages per acre and reduced water consumption.

The Bundaberg Sugar Experiment Station.

By N. J. KING.

"*The Sugar Experiment Stations Act of* 1900" provided for the establishment of Sugar Experiment Stations at selected centres throughout the sugar-producing belt of Queensland; but it was not until the end of 1913 that the present Bundaberg Station was instituted. The property—situated some 4 miles from Bundaberg—was an existing cane farm, and constituted 45 acres of average quality red volcanic soil of the well-known Woongarra scrub lands. A laboratory was established on the farm in 1914, and in the same year general field experimental work as well as laboratory analyses were commenced. It was at that time the headquarters of the Bureau activities—these being later transferred to Brisbane—and the Bundaberg Station became one of the centres of agricultural research, rather than farm and soil laboratory combined.

FIG. 32.—The Laboratory of the Bundaberg Station. In the foreground is shown the irrigation of the 1935 seedlings.

For some fifteen years after the inauguration of the Experiment Station its work was made up principally of farm trials on fertilizers and other soil amendments, the testing of new varieties for yield and sugar content, experiments in cultivation practice (subsoiling, ratooning methods, &c.), spacing trials, green manuring trials, methods of improving germination, and molasses experiments. Many of these trials have been repeated from time to time in modified forms to ensure that results obtained were not due to the particular seasonal conditions obtaining at the time.

The cane-producing portion of the station is divided into some fifteen blocks, so that a large number of experiments can be carried out at the same time. The block area is thus necessarily small, but the number of replications of a treatment or variety ensures a high degree of accuracy in the results.

About the year 1930 a definite modification of Experiment Station policy was inaugurated. Experiment Stations the world over were concentrating on cane breeding and the raising of seedlings suitable for their particular environment. Moreover, the disease position in Southern Queensland necessitated a drastic alteration to the variety situation, and it was thought that this could best be brought about by seedling raising at Bundaberg. As it was not possible to produce fertile seed locally, the arrows were obtained from South Johnstone Station and raised at Bundaberg. A modest beginning was made in 1930, and due to alteration in technique, the work rapidly advanced so that some 6,000 seedlings are now grown annually at the Bundaberg Station. Since the initiation of this policy the variety situation has become less serious owing to the importations of gum-resistant canes from overseas, but in spite of this the seedling programme undergoes constant expansion in the hope of producing locally, better canes than those already grown.

A considerable amount of time is required to prove a variety. The cane breeder must be quite sure of a seedling's performance before it can be distributed to growers. Some twelve months after the germination of the seed one stool of each seedling is available. It is necessary to introduce this seedling to disease-resistance trials, and to plant some of the setts to observe its ability to "strike" under field conditions. The sugar content must be known at different periods of the season, its ratooning qualities, and its ability to ratoon under favourable and adverse conditions. When all these factors are proved it remains only to be tested in variety trials against known standard varieties and, if superior, to be propagated in quantity for distribution. Some years are therefore required to test a new seedling thoroughly, and to distribute it as a commercial variety. At Bundaberg some of our seedlings have reached the varietal trial stage, which is the final test before distribution.

This new phase of investigational work necessitated a reduction of the area available for fertility and other trials on the Station, since a considerable percentage of the available land was required for seedlings in the various years of their experimental life. But to counteract this limitation of available area there was the simultaneous project of carrying out fertility trials on the growers' own farms. The success of this latter project is made manifest in the various January numbers of the Quarterly Bulletin, and the fertility trial work has been augmented in recent years by the planting of variety trials on various soil types throughout the area. These latter trials have given us a much better understanding of the varietal performance on many soil types than any other method could have supplied.

Gradually, as seedlings reach the varietal trial stage on the Experiment Station, more and more land will be required to plant them experimentally against standard canes; but until this time arrives our available land will continue with experiments of general interest to farmers. Some idea of the type of experiment carried out can be

obtained from the following list of trials at present in progress on the Station:—

(1) Trial with P.O.J. 2878 and 2725 (plant) which includes applications of sulphate of ammonia ranging from nil to 600 lb. per acre. This trial is irrigated.

(2) A 5 by 5 Latin square trial (plant) including Co. 290 and P.O.J. 2878, each variety being single and double planted.

(3) Varietal trial (third ratoon) including Q. 813, Co. 290, Co. 281, P.O.J. 234, 2725, and others.

(4) Irrigation trial with P.O.J. 2878 (first ratoon) with inter-space and row irrigation.

(5) Subsoiling cultivation trial (first ratoon) which also includes 4 feet and 4 feet 6 inches interspacing of P.O.J. 2878.

(6) Variety trial (plant) with P.O.J. 2878, 2725, 234, and Co. 290.

(7) Nitrogen trial (first ratoon) investigating the effect of time of application of sulphate of ammonia.

(8) Fertilizer trial (first ratoon) to differentiate between value of different forms of phosphate.

(9) Type of planting material trial (plant) with plants from different portions of the stick.

(10) Plant locality trial (plant) with plants of Q. 813 from different soil types.

(11) Seedling variety trial (plant) with nine selected seedlings against a standard variety.

(12) Blocks of first year seedlings and of selected seedlings from previous years.

(13) Permanent trash conservation trial on which half the area is harvested and the trash burnt, and on the other half the trash conserved yearly and ploughed in at the termination of the rotation. This block will be maintained permanently to observe soil and crop variation over a long period of years.

The foregoing exemplifies the scope of our work, and doubtless all trial results, whether positive or negative, will be of value to growers.

It was also realised in recent years that the furnishing and equipment of an up-to-date laboratory for the analysis of soils, fertilizers, irrigation waters, &c., would be a benefit to the South Queensland growers, and would also be valuable for more extensive research work than was possible in the past. This laboratory is now almost completed and will provide a service the lack of which has been long felt.

Another recent improvement to the Bundaberg Station, is the installation of a small irrigation plant with which we are able to irrigate some 6 acres of cane. Primarily the installation was made for the benefit of the first year seedlings, but it is also being utilized on a modest scale for irrigated field trials. The plant consists of a 7-H.P. Lister Diesel engine and a 3-inch vertical centrifugal pump of the Kelly-Lewis type. The maximum amount of water obtainable from the underground supply is about 10,000 gallons per hour. The water is of

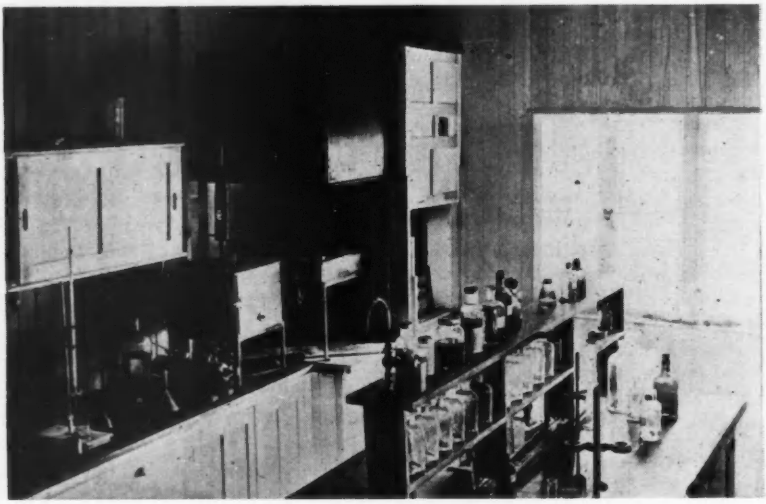

FIG. 33.—A corner of the newly-fitted chemical laboratory which is now available for the analysis of soils, fertilizers, irrigation waters, &c.

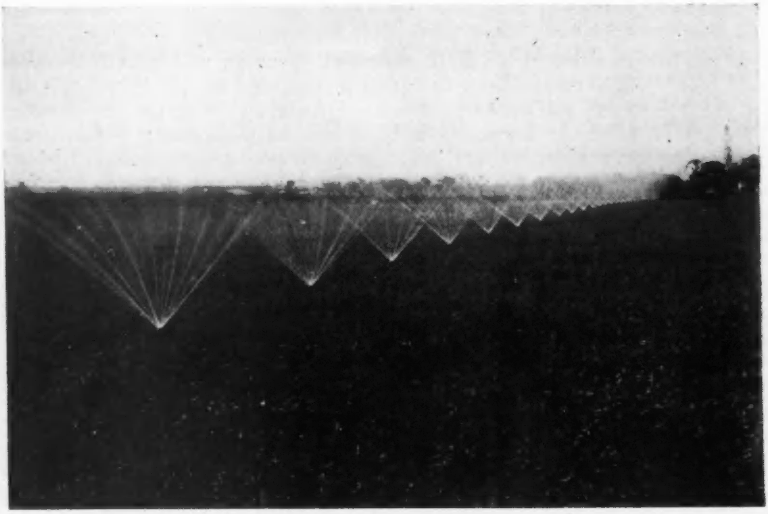

FIG. 34.—Operation of the spray system recently installed for the irrigation of lucerne.

excellent quality, containing some 2 to 3 grains of salt per gallon. An underground pipe system takes the water to various points on the Station where the most suitable irrigation blocks exist.

During the year 1935 a spray system was also installed to irrigate lucerne. The system to date has been an unqualified success and should be of interest to farmers on the Woongarra and other soil types. The lay-out consists of 4-inch galvanised iron round fluming in 17 feet 6 inches lengths with Noonan couplings. The sprays are placed 12 feet apart on the spray line, and have a covering capacity of 17 feet 6 inches on each side of the fluming. Under the conditions operating at the Station each spray delivers about 160 gallons per hour, and with a spray line 6 chains long, one-third of an acre of lucerne can be given a 3-inch watering in less than four hours. A youth can shift the spray line to its next position in less than an hour, so that an acre could be irrigated with 3 inches of water in approximately fourteen hours. The method in use at the Station is to utilize the pump for cane irrigation between 8 a.m. and 5 p.m., and then switch over to the lucerne spray line which can be operated until 8 or 9 p.m., when the engine is stopped. The following day, during cane irrigation, the fluming is moved to the next position and allowed to irrigate the next section that night. The success of the scheme can be gauged from the following data.

The block was sown with lucerne seed during May, 1935. The first cut was made in August and—following recommended practice—was allowed to remain on the ground. On 2nd October the second cut was made—a small one—but up to this time the spray line had not been used. On 16th December an excellent cut was obtained, and again another good cut on 28th January. The value of good rations for farm animals cannot be over-estimated, and the inclusion of such a scheme on any farm would be an insurance against lack of feed in the frequently recurring dry periods incidental to the Bundaberg climate.

Giant American Toad.

The Giant American Toad, which was introduced into Queensland from Hawaii last June, has apparently found conditions in North Queensland to be very congenial and has multiplied rapidly. Liberations of toads were made in the districts north of Cardwell, and these colonies appear to be establishing themselves satisfactorily.

Numerous enquiries have been received regarding the probable date on which batches of toads might be expected to be made available in the more southern districts, as, for example, the Isis district, where the toad is expected to be capable of dealing efficiently with the Childers cane grub. At the present time, however, it is impossible to forecast when such liberations might be made, as the Federal Department of Health has imposed a ban on the further distribution of the toad. It is the desire of the Director-General of Health that the results of the toad's introduction into the North be further studied before the ban can be lifted.

A.F.B.

The Breeding of New Varieties of Sugar-Cane.

By Arthur F. Bell.

POSSIBLY no phase of the agriculture of sugar-cane is now receiving as much attention by Experiment Stations as cane breeding, and rightly so. Yield per acre can be improved by various methods, most of which involve the expenditure of considerable sums of money, but once a variety of superior yielding power has been produced it continues to give higher returns per acre with no added outlay.

The cane-breeding programme of the Bureau is now undergoing considerable expansion, and so it was thought that a survey of the aims and methods used might be of some interest at this time. The conditions permitting the expansion of the programme are—

(*a*) The Northern Station has been transferred to Meringa, where the lower rainfall does not interfere so much with the shedding of the pollen of the male parents.

(*b*) The Mackay Station has been transferred to Te Kowai, thus permitting a larger and more representative area to be devoted to seedling raising.

(*c*) A small irrigation plant has been installed at the Bundaberg Station and this will ensure our being certain of raising seedlings under reasonably good conditions in the frequently recurring drought years.

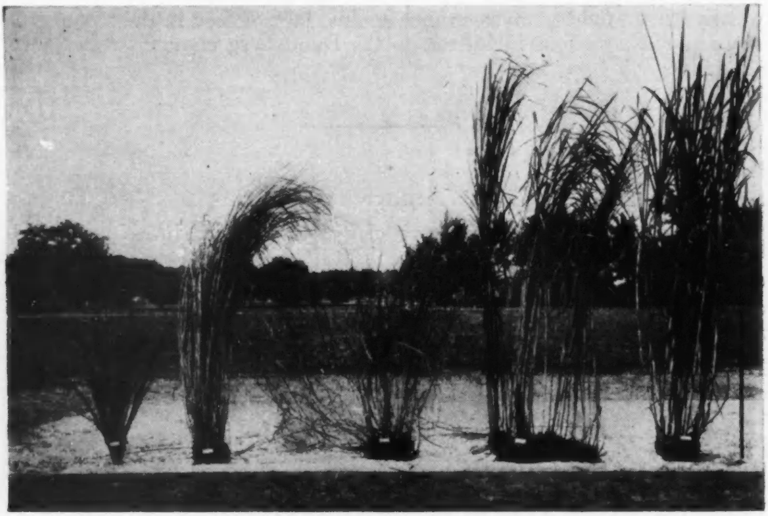

Fig. 35.

Showing the diversity in type of "wild" canes which may be used as parents in crosses with "noble" canes in order to introduce desirable characters in commercial canes. (After Venkatraman.)

It may be emphasised, however, that such irrigation as is used will not be excessive; over-good or over-bad conditions tend to bring the majority of seedlings to the same level and make selection impossible—our aim is to be certain of having reasonably good conditions.

Sugar-cane breeding dates back only to 1889, when seedlings were raised in both Java and the British West Indies, but it is interesting to note that the Queensland Acclimatisation Society was soon in the field and raised a few seedlings in 1890. This work was continued by the Society on a small scale until 1907, when it was abandoned; Q. 813 and Q. 1098 are the best known of the canes produced by this organisation. From 1901-5 seedling raising was carried out by the C.S.R. Company at their Hambledon Plantation, and here were bred the well-known H.Q. 426 (Clark's Seedling) and H.Q. 285. With the establishment of an Experiment Station within the tropics (South Johnstone) this Bureau was enabled to commence seedling raising in 1921, and S.J.4 is the best known of the early seedlings.

During this period most Sugar Experiment Stations had undertaken the breeding of new varieties of sugar-cane, but in general this work had not met with the success which had been anticipated, and the methods employed had not been greatly improved. Within recent years, however, rapid advances have been made, due in part to the better circulation of knowledge through the conferences of the International Society of Sugar Cane Technologists and the discovery of new species of sugar-cane and their value in breeding. In the early period at South Johnstone we were forced to breed only from the "noble" species, with the result that although many vigorous canes of high sugar content were produced, most of them were too "aristocratic" and could not withstand hard conditions or disease. At the present time we have available five species of sugar-cane, one of which was found by the aeroplane expedition led to New Guinea by Dr. E. W. Brandes in 1928. We have been forced, just as all plant and animal breeders are eventually forced, to go back and reintroduce "wild blood" in order to gain stamina.

Recently attempts have been made to cross sugar-cane with plants other than sugar-cane in the hope of building up crossbreeds which will contain some qualities at present lacking in cane. The most promising of these are the sugar-cane sorghum crosses carried out in India by T. S. Venkatraman, who recently visited Queensland as a delegate to the Congress of the International Society of Sugar Cane Technologists. In India, as in parts of Queensland, early maturing canes are a pressing need; it occurred to Mr. Venkatraman that perhaps the crossing of cane with a short cropping plant, such as sorghum, might bring about this result. The attempted crossing was successful and gave progeny which look more like cane than sorghum and reach maturity in five to six months. Unfortunately, they still lack vigour, although the sugar content is reported to be good. It would appear that by back crossing on to cane for one or two generations there is a fair chance that a cane (or should we say a "sorg-cane"?) will be produced having vigour, high sugar content, and early maturity. Four of these first crosses have been introduced into Queensland and will shortly be taken up to Meringa, where it is hoped that they will arrow and enable Mr. Barke to effect crosses back to cane.

The methods employed in raising seedlings vary considerably in detail according to conditions and cost of labour available. In Queensland the general technique is as follows:—Varieties which it is thought

desirable to try out as parents are planted in a plot in the Freshwater district, near Cairns, where arrowing is usually heavy. In making any particular cross the arrow of the cane selected as the female parent is left growing in the field; just before the flowers commence to open this arrow is surrounded with several arrows of the variety selected as the male parent. The stalks of the latter are stood in a special solution containing sulphurous and phosphoric acids (see Fig. 36); this solution

Fig. 36.

Arrows of the variety selected as male parents are stood in a special solution and carried to the field, where they are set around the female arrow. (After Mangelsdorf.)

will keep the stalk and arrow alive for weeks, and will allow the normal shedding of the pollen to continue. The canes of the male variety are tapped lightly each morning in order to facilitate the shedding of the pollen.

It is very desirable that the parentage of each seedling should be known with certainty; consequently the variety used as the female parent is chosen because it produces little or no pollen and the male arrows are clustered closely around so as to prevent the deposition of any pollen from other varieties growing nearby. In the case of the older seedlings, such as B. 208 and Q. 813, the seed was just collected in the field, and so only the female parent is known; as a result we are unable to repeat the crosses which produced them.

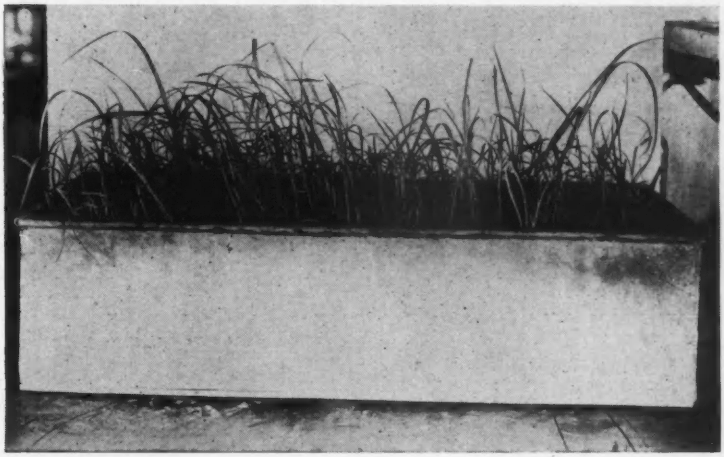

Fig. 37.
Seedlings growing in the germination flat, five weeks old, and ready for potting.
[*Photo. by N. J. King.*

When all the tiny flowers on the female arrow have opened and died off, the male arrows are removed and the female arrow is bagged until the seed has ripened, this ripening usually taking some two or three weeks. The seeds are considerably smaller than a pin's head and are light to dark-brown in colour. They do not keep well and, unless stored under special conditions, must be planted immediately if reasonable results are to be obtained. Seed will not set on the arrows produced by the cane in the Mackay and Bundaberg districts, and so all crossing work is carried out at Freshwater and the "fuzz" is sent to the other stations for germination.

The seed is planted in flat wooden boxes containing a mixture of soil, well-rotted manure or leaf-mould, and sand, only a light covering of soil being applied. The boxes are usually set in glass houses or frames which can be heated during the late winter and early spring months when germination is carried out. The seeds germinate after a few days, and the young seedlings appear very similar to certain young grass seedlings at this stage. They are very delicate, and for some time require constant attention to prevent damage by heat, low humidity, or damping-off fungi.

At the age of about four to five weeks they are transplanted from the flats into pots consisting of a length of galvanised iron piping, about 8 inches long by about 3 inches in diameter (see Fig. 39). After about eight weeks' further growth they are transplanted into the field. A hole is dug at the base of a plough furrow and the core of soil, with the roots intact, is tapped out and set in the hole. The seedlings then grow in the field until about August or September, when the selection of the best canes is made.

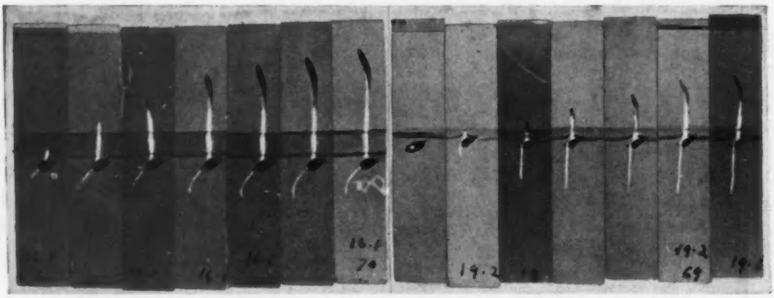

Fig. 38.

Photographs taken at daily intervals after the sugar-cane seed has germinated. The seedling on the left had as parents P.O.J. 2878 and P.O.J. 2940, while that on the right was obtained from P.O.J. 2722 and H.Q. 409.

[*Photographs by W. Cottrell Dormer.*

Fig. 39.

Young sugar-cane seedlings growing in galvanised iron tubes; these seedlings are ready for transplanting into the field.

[*" Telegraph," Photo.*

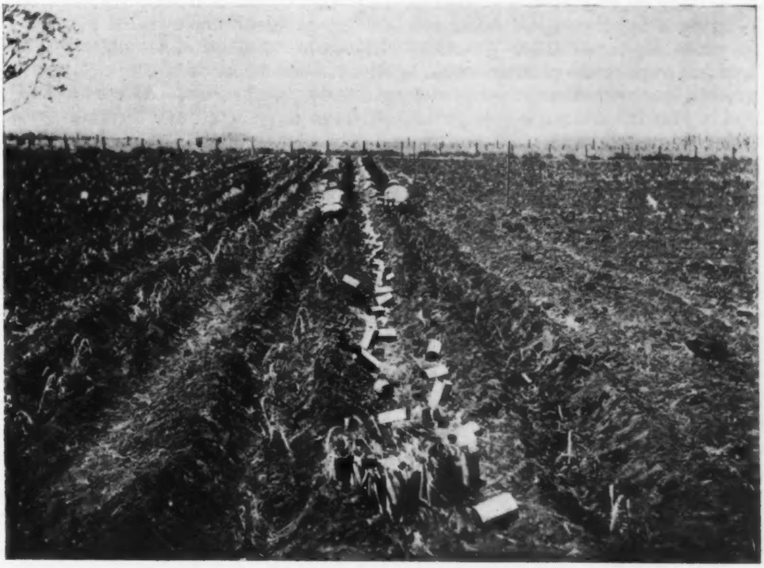

Fig. 40.

Seedlings being transplanted from pots to field at the Bundaberg Experiment Station.

[Photo. by N. J. King.

Fig. 41.

Photograph illustrating difference in growth in adjacent seedlings of the same cross. Age, five months.

[Photo. by N. J. King.

The progeny of any one cross may vary to an extraordinary degree, ranging from fine upstanding stools of 10 to 12 or more stalks per stool, to units which produce practically no cane. Selection is made on the basis of vigour of growth, sugar content, formation of the eyes, type of growth (i.e., whether it is sprawling or not), and so on. As a rule, only about one in a hundred original seedlings is selected for further trial. Thus, if we raise 10,000 seedlings, only about 100 are selected for a second planting, the rest being milled and discarded. It might be thought that such wholesale rejection is rather severe, but there are two points to be borne in mind. Firstly, if we can produce one really good seedling per year which will replace a standard variety, we will be more than satisfied, and if there is only one really good seedling in a batch of 10,000, then it surely should be included in the hundred selected. Secondly, the area of land and facilities available do not permit the handling of large numbers of second and third year seedlings.

Such seedlings as are selected from the original stools are planted out in short rows interspaced with standard varieties and, at maturity, selections are again carried out as in the first year, but naturally with closer attention to detail; about 10 per cent. of these are selected. Third and fourth year tests are carried out on a larger scale, and attention is paid to germination and ratooning qualities, while in the meantime resistance to major diseases has been determined. Finally the 10,000 seedlings are reduced to perhaps two or three which are considered worthy of trial on farms, and these are then set out in comparative trials with standard varieties on different soil types.

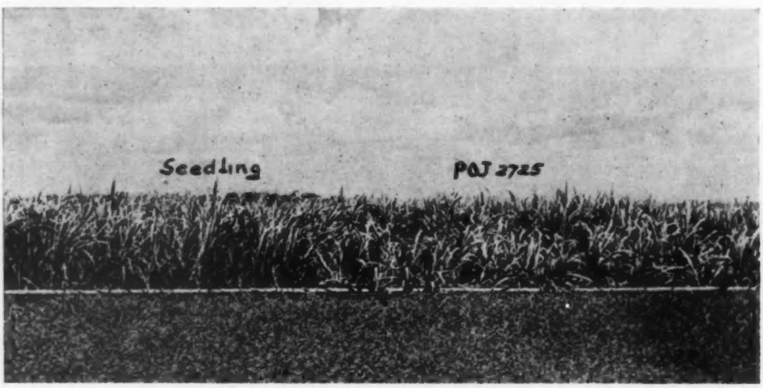

FIG. 42.

Comparison of P.O.J. 2725 and a seedling raised and now being tested at the Bundaberg Station.

[Photo. by N. J. King.

The two outstanding seedlings which have been produced since cane breeding began are P.O.J. 2878 in Java and H. 109 in Hawaii. P.O.J. 2878 was rapidly planted to 98 per cent. of the area, but, unfortunately for the Java planters, they have not reaped the full benefit of this cane owing to drastic reductions in their sugar markets. In Hawaii, even if the Experiment Station had never done anything else of value, its existence would still have been eminently justified, since the cost of its maintenance since its inception has been many times repaid by the extra profit accruing from the planting of H. 109.

The qualities required in a cane breeder are many. He must be a model of patience, painstaking care, and capacity for hard work and long hours. He must be optimistic with an optimism tempered by caution; stout-hearted so that he shall not despair when a promising "world beater" must be discarded on account of disease susceptibility; sympathetic towards and intensely interested in his large family, but ruthless in his destruction of all members who fall short of rigid standards.

On the other hand, the canegrower himself must also be optimistic regarding the final results of a cane-breeding programme. We must ask him to be patient and tolerant also, since it requires time to determine the types of cross and then develop the individuals best suited to the soil, climate, agricultural and disease conditions of each district.

A final word. We are sometimes asked the question, "Why try to breed superior varieties when there is already over-production of sugar?" The answer lies in the reason why farmers till their land before planting and cultivate and fertilize the crop. The function of an Experiment Station, through the efforts of its plant-breeding staff, is to produce superior canes of higher sugar content and thus reduce the unit cost of sugar per acre. The question as to what extent over-production exists and how it shall be controlled is a problem for the economic and not the agricultural advisers of the industry.

Identification of Rats Damaging Cane in Queensland Canefields.

By W. A. McDOUGALL.

DURING the many years prior to 1934 when rats damaged cane in Queensland, they were never referred to under any name but the common collective one of "rats." Undoubtedly, this name fully serves its purpose in several ways, but to those seriously interested in attempting to control these pests it is not sufficient.

The amount of research work done on any pest usually bears some relationship to the losses caused by the pest. This is well illustrated by happenings in the Herbert River cane areas during the past two years. There in 1933 and 1934, exceptionally heavy rat damage to cane was experienced. Control measures were applied, but a further result of these heavy infestations was that work was commenced by local mill and pest board officers to find out something of the habits, &c., of the particular rats with which they were dealing—i.e., of the rats which were found to be pests of cane. At an early stage the different kinds of rats were separated and were submitted for identification to competent authorities. Three species were found to be of interest to the cane farmer—viz., *Rattus rattus*, *Rattus culmorum*, and *Melomys littoralis*.

Unfortunately, at the present time, very little is definitely known about rat species in Queensland cane districts, other than the Herbert River, and knowledge of the wider distribution of some of the important species occurring there is very scant.

Rattus rattus (the House Rat) is a world-wide species but, as far as is known, it is not a very serious cane pest in Queensland. *Rattus norvegicus,* the species which is considered as being of considerable importance as a pest of cane in Hawaii, has not been reported, as yet, as

FIG. 43.
Tree-rat nest in Pandanus.

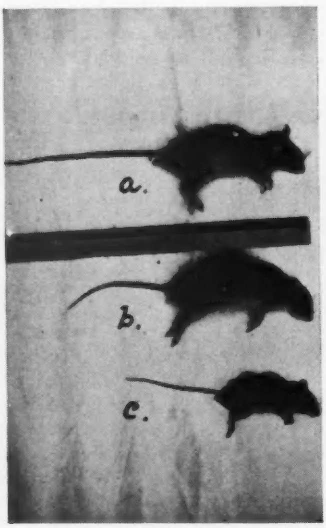

FIG. 44.
(*a*) House rat (*Rattus rattus*).
(*b*) Field rat (*Rattus culmorum*).
(*c*) Tree rat (*Melomys littoralis*).

FIG. 45.
Typical field rat burrow entrance under a cane stool.

[*Photos. after Gard.*

damaging cane in Queensland, although it is present in cities of the State. The known locality records of *M. littoralis* are Cairns, Ingham, Innisfail, and Ayr. Specimens of *R. culmorum* have been identified from Ingham, Ayr, the Innisfail district, and from the Habana area of

Mackay (November, 1935). At the present time this last-mentioned species, which is native to the country, is considered to be of the most importance to Queensland cane farmers. Under such circumstances it is very desirable that as much as possible should be known about its distribution, habits and characteristics, and the farmer should be able to distinguish it from other rats. As an aid towards these ends the following brief descriptions of some of the rats which may be found in cane in Queensland are set out below, together with the correct method for forwarding rat specimens to any of the Sugar Experiment Stations. Farmers are requested to do this as it will be of considerable help in increasing our knowledge of rats and their distribution in Queensland cane areas. Some species of the coast areas of Queensland had not been recorded since first found and described many years ago. Rats from both canefields and outside country are desired; if taken from canefields it is suggested that the specimens should be taken from spots not in close proximity to buildings.

Rattus rattus (the House Rat).

The total length of the head and body of a full-grown adult of this species is about 8 inches. Its colour is very variable. The fur is fairly soft but sparse and the lack of thick under-fur gives the coat, as a whole, a somewhat thin, harsh quality. The ears are large, almost free of hair, and leafy in appearance. This species can be distinguished from the others by its extremely long, slender tail which, when held back over the body, reaches an inch or more beyond the tip of the rather sharp nose. Although known as the "ship" and "house" rat it is also found in the bush.

Rattus culmorum (the Coarse-haired or Spiny-haired Rat).

In the Herbert River district this species is called the Field Rat. It is usually smaller than the House Rat and the fur is much denser but rather coarse, and the presence of more or less numerous flattened spines gives the coat a harsh touch and appearance. The general colour, although variable, is dark-brownish flecked with lighter buff-brown. The sides are greyer and the belly is duff-white, often with a tinge of yellow, but never pure white as in some individuals of *Rattus rattus*. The muzzle is not as pointed as in the House Rat. The ears are short and practically naked. The tail when held back over the body reaches to about the shoulders.

Melomys littoralis.

This rat is called the "Tree," "Fruit," "Banana," or "Khaki" rat by farmers in the Herbert River mill areas. The last-named is a reasonably fair indication of its colour. In size it is much smaller and it is softer haired than the three *Rattus* species previously mentioned. It differs from them also in the number of teats; instead of 10-12 the female possesses 4 only. The main character of the genus Melomys is the almost naked tail with its patterned instead of ringed scales.

Preparation of Rat Specimens.

If "break-back" traps are being used the specimen should be collected as early as possible during the first morning of its death. Before it is placed in undiluted methylated spirits a slit of about 2 inches should be made along the centre of the belly of the dead rat. Specimens

should not be crowded into receptacles (preferably air-tight) and they should be well covered with the preservative. After a week or more—i.e., when the flesh is well hardened—the specimens may be wrapped in some material, such as cotton wool or rags which will absorb spirits. Then the specimens, with wrapping well saturated with spirits, may be packed in leakless tins or other suitable containers for forwarding to the desired destination.

Modification of the "Spinner" Weeder.

During the recent International Conference of Sugar Cane Technologists the agricultural representatives from Hawaii reported very favourably on a cane-weeding implement which has been constructed from a pair of modified Australian spinners. The manner in which this has been effected is evident from the accompanying illustration (Fig. 46).

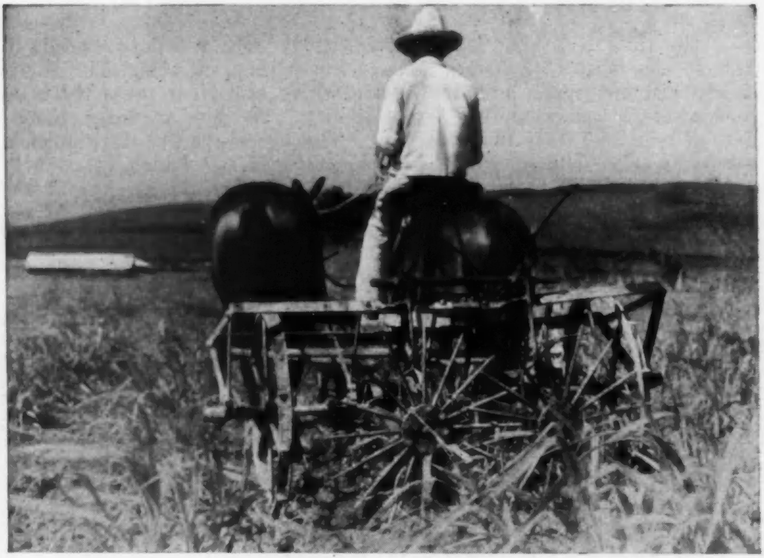

Fig. 46.—Illustrating the manner in which two Australian spinners have been combined to give a double weeder.

It consists of two revolving weeders from which one right-hand and one left-hand wheel are removed and the frames bolted together. This was found to be a marked improvement over the single spinner, and could be employed successfully with ratoons.

Even better results were obtained when the rigid tines were replaced by brush wire rotors. The action of the brushes is then similar to that of the road sweeper, and while it readily removes small weeds from plant or ratoon crops it does not damage the young shoots. This modification should readily commend itself to Queensland canegrowers.

H.W.K.

Spray Irrigation.

By H. W. Kerr.

SPRAY irrigation has been employed successfully with many crops, notably vegetables, small fruits, and lucerne. With sugar-cane it has received only scant attention, although quite an extensive system was seen on one of the plantations of Hawaii ten years ago, when experiments were also being conducted at the Waipio Sub-station of the Hawaiian Sugar Planters' Experiment Station. The chief drawbacks to the wider employment of the system were (1) the cost of the installation, (2) the faulty distribution of water due to inherent imperfections in sprinkler design and interference from wind.

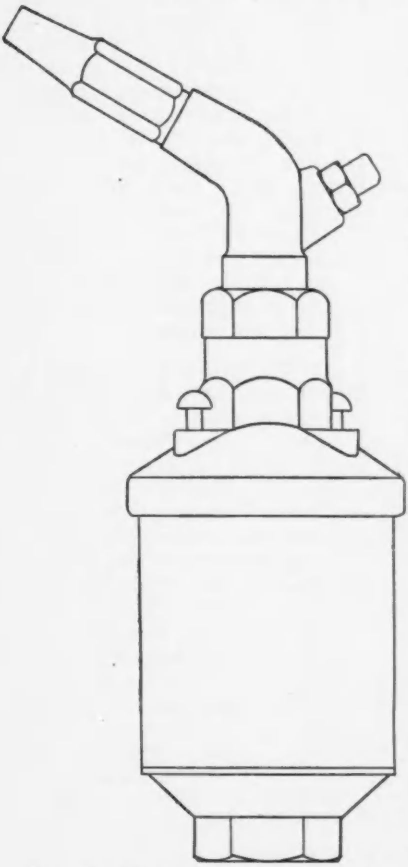

Fig. 47.—Illustrating the high-coverage irrigation sprinkler.

At about that time the Thompson Manufacturing Company of California became interested in the problem, and devoted attention to the possibility of supplying a satisfactory sprinkler of wide coverage, so as to reduce the amount of pipe line required. The reduction in the number of sprinklers per acre demanded, of course, increased nozzle size and operating pressure to enable a given amount of water to be applied in reasonable time. The first model developed (Fig. 47) was partially successful, and the number of sprinklers per acre was reduced to less than nine. More recently, a further improvement in design has permitted the production of sprinklers with the following characteristics:—

	Sprinkler (a).	Sprinkler (b).
Diameter of nozzle	$\frac{3}{8}$-inch ..	7/16-inch
Discharge of sprinkler ..	29 G.P.M. ..	42 G.P.M.
Nozzle pressure	45 lb. ..	60 lb.
Sprinklers per acre	3·0 ..	2.37

The greatly improved coverage provided by this system allows of big reduction in the amount of piping required, although this is, naturally, of larger diameter. At the same time it permits of the pipe line being laid on the land surface without seriously interfering with cultivating operations.

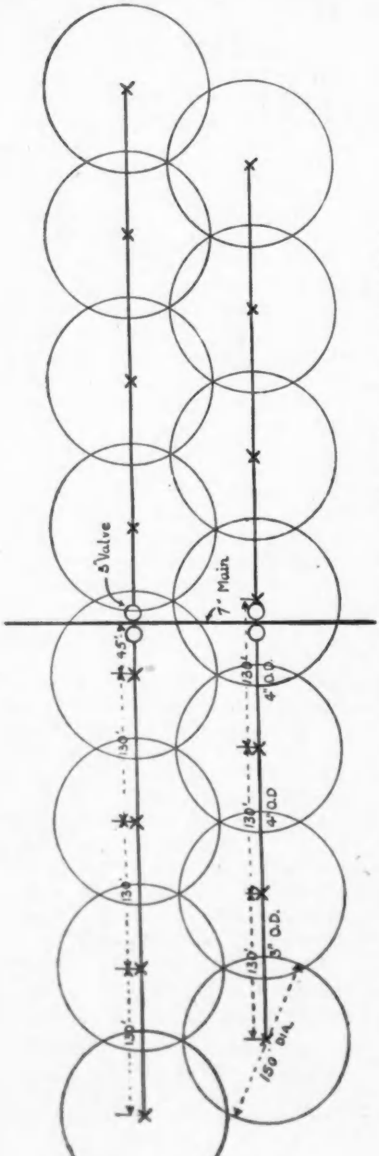

FIG. 48.—Illustrating the Arrangement of Pipe-lines and Sprinklers for a 5-acre Unit.

The Sprinkler.

The construction of the sprinkler is such as to ensure positive action; that is, the slow speed at which the nozzle must revolve is achieved by a small water wheel placed horizontally in the base of the sprinkler, which is operated at a high speed by the large volume of water which passes it. By means of a series of gears, packed in a watertight case filled with grease, the positive drive is transmitted to the nozzle through a reduction of 3,750 to one. The nozzle then revolves once in two minutes, and there is but slight danger of failure.

The sprinkler is provided with two jets—the smaller delivers a fan-like spray, which covers a circle adjacent to the standpipe; the larger takes care of a wide ring surrounding this circle. Together these provide a coverage over a circle 150 feet in diameter in the case of sprinkler (*a*), when set on a standpipe 30 feet high. This installation was designed essentially for banana plantations, and for cane growing the height of the standpipe would probably be reduced to 18 to 24 feet, depending on the habit of growth of the variety; a reduction in height would, of course, substantially affect the coverage.

The Installation.

Fig. 48 supplies the essential data for one unit of a large installation employing sprinklers of $\frac{3}{8}$-inch nozzle diameter. This unit is 5 acres in extent, and all sprinklers are operated simultaneously.

The pipe consists of black steel piping with outside diameters (O.D.) as shown; it is specially bevelled for welding in the field. Welding results in a reduced installation cost, but increases the difficulty of moving the pipe line later. The standpipes (Fig. 49) consist of 10 feet of 2 inch, 10 feet of 1½ inch, and 10 feet of 1¼-inch piping screwed together. The following are the costs supplied by the American Company:—

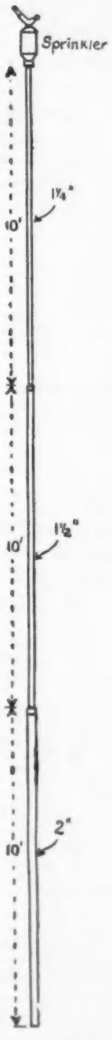

Fig. 49.—Illustrating the Standpipe and Sprinkler Set-up.

		$	$
Plain steel pipe 7 in. O.D.,	220 ft. @	0·72	158·40
Plain steel pipe 4 in. O.D.,	1,170 ft. @	·27	315·90
Plain steel pipe 3 in. O.D.,	520 ft. @	·18	93·60
Screwed stand pipe 2 in.	150 ft. @	·19	28·50
Screwed stand pipe 1½ in.	150 ft. @	·14	21·00
Screwed stand pipe 1¼ in.	150 ft. @	·12	18·00
15 super rotor sprinklers	@	10·40	156·00
4 3-in. iron clamp gate valves	@	9·20	36·80
Material for 5-acre unit		=	828·20
1 acre		=	$165·64

Allowing $4·00 as equal to £1 Australian currency, the cost of the material for this installation on the above values would be about £41 10s. per acre. To this must be added the cost of installing a suitable pump and engine. A two-stage centrifugal pump will be necessary to provide the high nozzle pressure required, and take care of friction losses in the pipe line. These have been estimated as follows:—

	lb.
Nozzle pressure	45
Loss of head in lateral	6
Loss of head in elevation of sprinkler ..	13
Loss of head in standpipe	2
Loss of head in 2,000-ft. main	17
Minimum pressure at pump ..	83

Provision must be made also for the suction and delivery head involved in raising the water from the spear or well to the land surface. On the above figures it is estimated that an engine of 40-h.p. would be necessary, operating a 5-inch pump.

With fifteen sprays working at the same time and delivering ¼-inch per hour, a 3-inch watering will be completed in twelve hours. From these figures it may be calculated that 429 sprinklers will water 143 acres in fourteen days if the unit be operated twenty-four hours per day.

With a similar installation employing the nozzles of 7/16-inch diameter, a 70-h.p. motor will enable 429 sprinklers to water 181 acres in fourteen days (twenty-four hours' operation). The cost of the pipe line installation would be practically the same as the alternative scheme described.

Unit Installed at Ayr.

During the past year a small spray system employing these imported sprinklers was laid out at Ayr. Although one object of the layout was to determine the practicability of spray irrigation, it should be made quite clear that the main purpose was the provision of a scheme which would permit of accurately controlled water application for irrigation experimental work, which it is hoped may be carried out at this centre.

Through the courtesy of Messrs. Landa and Co., an area of about 3 acres of land was made available for our use. A well was sunk, and a 2½-inch two-stage pump, operated by a 15-h.p. electric motor, was supplied from a 6-inch slotted brass spear. A 3-inch diameter galvanised pipe line (Fig. 50) carried the water to the edge of the field, where the

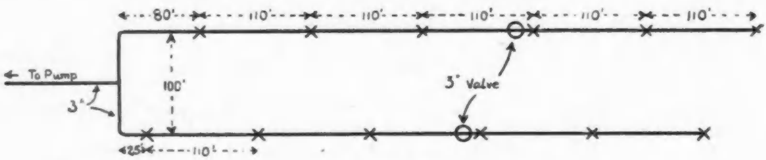

Fig. 50.—Plan of the Pipe-line System installed at Ayr for Experimental Purposes.

line was divided into two branches, each carrying six sprinklers. As the standpipes were reduced to 18 feet in length, the distance between sprinklers was fixed at 110 feet, with 100 feet between the pipe lines. This installation was capable of operating three sprinklers simultaneously. With this arrangement it required three hours to apply 1 acre-inch of water.

Our first experiment was designed to determine the effect of the amount of irrigation water applied at each watering. One-half of the area received 2 acre-inches, and the other 3 acre-inches. The intervals between applications varied with the season of the year—from three weeks in the cooler months of slow growth, to nine days in the months of December, January, and February—the season of vigorous growth.

The spring and early summer months were unusually hot and dry, even for this district, and it was early evident that, under these conditions, the 3-inch application was much superior to the 2-inch watering. The full details of the experiment will, however, be deferred until the crop is harvested.

It was found that wind interfered seriously with the evenness of water distribution, and for experimental purposes it was found necessary to conduct the watering during the night hours. Under still atmospheric conditions, measurements made with a series of tin cans spaced over the field showed that the distribution was quite good. For a 3-inch application, for example, the measurements ranged from 2¾ inches to 3¼ inches. In spite of the dryness of the season, little in the nature of dry spots could be detected in the crop growth, which could not be explained by visible soil variations.

Advantages and Disadvantages of the System.

The following summarises the main advantages and drawbacks of spray irrigation:—

Advantages.

(1) Economy in water utilization due to evenness of distribution of even light applications.

(2) Complete elimination of seepage losses from drains.

(3) Reduction in water distribution costs with respect to (*a*) labour in watering, (*b*) labour and implements in forming water-furrows.

(4) Flat cultivation is possible and an increased number of ratoon crops should be profitable.

(5) Trash conservation may be practised with ease.

(6) Fire protection, as sprinklers may be operated to control accidental burning.

Disadvantages.

(1) High cost of installation. On figures supplied recently by a Brisbane firm, threaded black steel tubing similar to that specified would cost about £39 per acre, to which should be added the cost of sprinklers. The cost per acre could be reduced somewhat if the sprinklers were transferred from field to field as required. It is estimated that the steel pipe line, if laid on the surface of the soil, should have an average lifetime of twenty-five years.

(2) High pressures, necessitating an increase in engine power over that normally employed. This would be partially or possibly completely off-set by the reduced volume of water required, with even distribution and elimination of seepage losses.

(3) Moving of pipe line when ploughing. This could be eliminated almost entirely if the main were buried to a depth of 12 to 15 inches, and ploughing confined to the area between surface laterals.

Conclusion.

The results obtained from the trial plot installed by the Bureau at Ayr should, in the course of two or three years, supply data which will permit of a true estimate of the value of spray irrigation. The financial outlay must, however, always remain a serious obstacle to its extensive adoption.

Sulphate of Ammonia—Does it Evaporate?

This is a question which we are repeatedly asked, despite a detailed discussion of the point in an earlier issue. We would repeat that it may be applied quite safely in dry weather, and it will be taken into the soil by the first rains or even by the dew.

Further, it is not necessary to throw the material into the stool. It is much simpler and just as good to apply alongside the stool; and one-side application is just as good as uniform distribution on both.

H.W.K.

A Hot-Water System for the Farm.

By H. W. KERR.

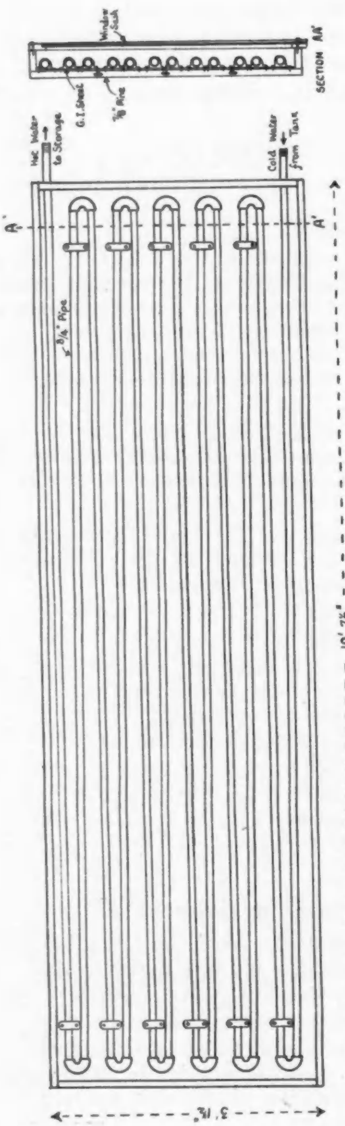

FIG. 51.—Illustrating the construction of the heat-absorption coil and glass-covered box.

THE average household needs much hot water for bathing and cleansing purposes, and this is particularly true on the farm. Yet the absence of conveniences for its provision at short notice generally means that it is not available as desired, and the farmer and his family must get along without it. For those who are prepared to expend a few pounds in the construction of a simple system in which operating costs are practically nil a description of the so-called "Solar Heater" is here supplied. It has been developed in America, and has also been widely adopted around the mills and plantations in Hawaii. It seems to offer a practical means of supplying hot water for the farm.

The system depends for its success on the ability of an exposed metal surface, when protected from the wind by a glass frame, to absorb heat from the sun's rays. If the metal surface takes the form of a continuous coil of iron piping the heat thus absorbed may be transmitted to water circulating in the coil; and if the heated water can be removed to a storage vessel and replaced by cold the process may be continued so long as the sun is shining.

The layout may best be described with reference to the accompanying diagrams (Figs. 51 and 52). In Fig. 51 is shown the plan of the heating coil, together with a section *AA'* through the box. The latter is 10 feet 6 inches by 3 feet internal dimensions, and is constructed of ¾-inch timber. The sides are 3 inches high. The bottom is lined with a sheet of

galvanised iron. On this is clamped a coil constructed as shown from $\frac{3}{4}$-inch piping. The galvanised sheet and the piping should be painted dull black. The lid of the box consists of glazed window sashes, which prevent air currents from cooling off the pipes, yet allow free penetration of light. This box is set on the roof of a building or other suitable location at such an angle as to afford maximum exposure to the rays of the sun. In Queensland it will require a northern exposure, and should be tilted at an angle of 20 to 30° with the horizontal. In the far-northern areas the lower angle should be employed, while 30° would be most suitable in Southern Queensland.

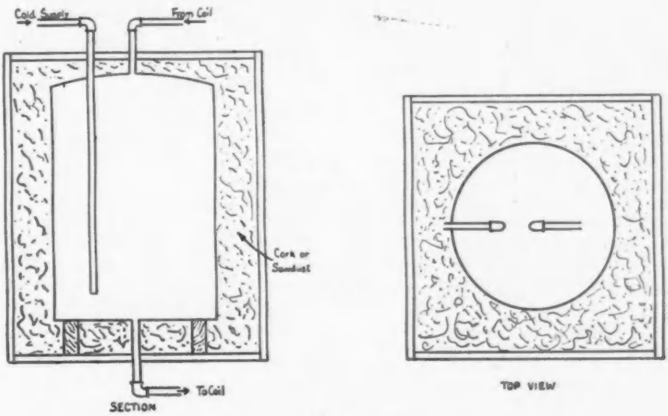

Fig. 52.

Showing the construction of the hot water storage tank and the manner in which it is insulated.

The free ends of the coil pipe are led to the water storage tank (Fig. 52), which is placed either between the ceiling and the roof of the building or in a specially constructed chamber on the roof. Care should be taken to provide a tank of ample proportions—one of 50 to 60 gallons capacity is generally suitable. This should be placed in a wooden box which will allow of a thick insulating layer of fine cork, sawdust, or fine, dry bagasse all around. This is a most important factor in the retention of the water at a high temperature. A cold water supply from a high house tank or water main should be brought into the storage cistern, as shown, while the hot water connection for the household supply may be taken off from any convenient point near the top of the cistern. A tee on the pipe from the top of the coil across to the storage tank will prove satisfactory.

For those who wish to alter the dimensions of the installation suggested it may be taken as a useful guide that under normal conditions 1 square foot of surface area should be allowed for each gallon of water to be heated to a temperature of 150° F. It may be of interest to point out, also, that some heat is absorbed by this system even on hazy or cloudy days. Naturally the solar heater would be best suited to those districts which enjoy a high proportion of clear, sunny days, but its usefulness should also be considerable in the high rainfall areas, particularly during the winter season.

Tung Oil Production.

A recent publication from the Imperial Bureau of Soil Science, England, reviews the present position with respect to tung oil production, and suggests that the future of the industry is distinctly promising. The oil has become an indispensable raw material of the paint and varnish trade throughout the world, while the aviation and electrical engineering trades have all tended to promote a marked interest in establishing the tung oil tree in countries other than China, which for years held the monopoly of the tung oil trade.

The oil possesses properties similar to those of linseed oil; it is considered, also, that the oil will always command a price at least £10 per ton above that of linseed oil. An acre of suitable land is stated to be capable of producing up to 1,200 lb. of tung oil. The tree has been established successfully on a commercial basis in Florida and neighbouring States, and in 1934 29,000 acres had been planted to the crop. Test plantings have also been made in India, South Africa, Australia, and other parts of the British Empire.

Many reports from these centres stress the significance of careful nursery management, and lack of attention to this would appear to be the cause of many avoidable failures. Two species of tree are cultivated—*Aleurites montana,* which appears to withstand heavier rainfall and requires higher temperatures than *Aleurites fordii,* from which the true tung oil is derived. The latter is generally regarded as yielding the superior oil, and this species is generally favoured wherever the crop is propagated successfully.

The search for alternative and profitable crops to supplement canegrowing, which is constantly engaging the attention of Queensland canegrowers, suggests that the tung tree is worthy of closer attention. The fact that no definite provision has been made for the construction of factories to treat the mature nuts should not be lost sight of, though this difficulty could probably be overcome by the installation of the necessary auxiliary plant at the sugar mills.

H.W.K.

David Whyte, Government Printer, Brisbane.